Training manual for small-scale bean producers in Southern highlands of Tanzania




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CIAT
Centro Internacional de Agricultura Tropical
Desde 1967 Ciencia para cultivar el cambio

PABRA
Pan-Africa Bean Research Alliance
Better Beans for Africa

Introduction

Common bean (*Phaseolus vulgaris*. L) production in East Africa is constrained by both abiotic and biotic stresses. Among the biotic stresses, insect pests and diseases have become the major elements of economic importance.

New technologies of bean production have been developed through Agricultural Research Institute-Uyole in partnership with CGIAR centers but some of them yet not adequately been disseminated and adopted to benefit farmers. This has led to current state of low and declining productivity common bean making production challenging. Poor agronomic practices and other inputs is the major limitations to crop productivity.

Since significant losses caused by these constraints are observed at the early stages of the bean growth cycle, the application of a product that confer protection against the early bean attackers would be of great importance. The product that contains both fungicide and insecticidal activity is applied as a seed dresser before planting.

The aim of the manual is to provide information on proper steps to follow during bean production, and the different descriptions of the common bean root rots and insect pest that are affecting the small scale bean producers.

- **Objectives of the manual**

1) To promote the adoption of improved bean varieties and use of seed dresser Apron Star.

2)To sensitize farmers on the possible diseases and pests to be encountered in fields and their management options.

3) To guide the farmers with simple and clear identification of the bean root rot diseases and insect pest targeted by the seed dressing product.

Acknowledgement

In preparation of this manual, we made a meaningful use of the contents in the published handbooks for small scale seed producers (1, 2 and 4), presentations, leaflets, pocket booklets and research reports.

We would like to acknowledge the inputs from the ARI-Uyole Administration, Bean Research team (David kabungo, Michael Kilango and Aida Magelanga), CIAT-Uganda team (Fred Kato, Clare Mukankusi and Warren Arinaitwe), CIAT-Tanzania team (Jovin Lwehabura, Jean Claude Rubyogo and others.

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Contents

Bean agronomy

The following steps must be followed to produce good quality bean grains.

1. Ecological requirements:

- **Temperatures:** these should range from 12-32oC. Avoid extreme temperatures and coldness.
- **Rainfall:** This should range from 750 – 1800 mm
- **Altitude:** Beans grow well at altitudes from 400-2000 m.a.sl.

2. Selection of bean varieties .

- This should be based on the varieties that you know have market (Farmer preferred), high yielding potential, disease resistance/tolerance and drought tolerance.

3. Source of bean seed

This should be obtained from known sources as farmers producing seed (quality declared seed), seed companies (Certified seed) or research institutions.

4. Selection of clean good quality bean seed.

- Seed sorting should be done to obtain good clean seed by removing diseased, mixtures and foreign materials for next planting/ subsequent seasons.

5. Selection of planting site.

- To ensure high bean yields, select highly productive land suitable for bean production. Avoid steep sloppy land, very sandy soils and areas with shallow surface soils.

6. Land preparation.

- This should be started early by land clearing, ploughing deeply and harrowing. Beans can be grown in ridges or on flat depending on the nature of soils and land surface.

Bean agronomy

7. Planting time:

- This varies from place to place. In areas with short rains, make sure you plant early maturing varieties and in areas with long rains, plant late maturing varieties. Also make sure the beans mature towards the end of the rainy period or at the beginning of dry period.

8. Soil fertility (Types of fertilizers).

- **Organic fertilizers** such as farm yard manures, it is recommended to apply before ploughing/harrowing. Dosage: 2000-5000 kg per acre.
- **Inorganic fertilizers** such as DAP, TSP + CAN etc. , it is recommended to apply during planting. For each acre, apply recommended dose e.g. 50kg of DAP, 50kg of TSP plus 25 kg of CAN per acre.

9. Planting the seed

- **Spacing** : 50 cm x 10 cm.
- When planting different varieties, separate and maintain the spacing of 2 m between areas from each variety to avoid mechanical mixtures.

10. Weeding

- **T**his should be done by either hand weeding or use of herbicides. at least 1-2 times each season. First weeding at 3 weeks after planting the bean seed and the next weeding will depend on weed occurrence and crop growth.

11. **Controlling insect pests and disease.**

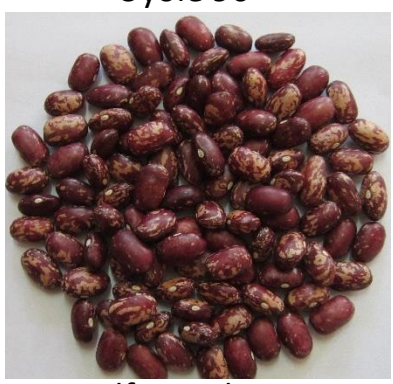
- Regularly check the field for insects and diseases. Insect pests can be controlled by spraying with effective chemicals. While the root rot infected plants should be rogued and buried deeply in the ground.

Different types of bean varieties

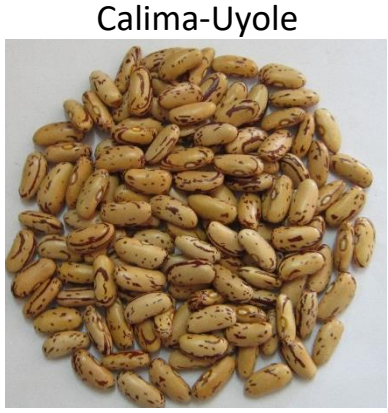

Uyole 96

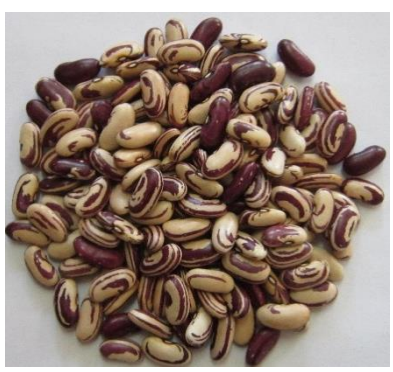

Uyole 84


Calima-Uyole


Bilfa-Uyole


Njano-Uyole


Uyole-03


Uyole-94


Uyole-04


Wanja


Uyole-98


Nyewuupe


Uyole-16

Bean variety description

S/N	Varieties	characteristics	Yield potential(tonnes/ hectacre)	
1.	**Kabanima**	Medium-large, Calima type, bush	1.5-2.5	
2.	**Uyole 84**	Climber with medium, beige seed color	1.5-4.0	
3.	**Uyole 94**	Red striped semi climber stripes	1.2-2.0	
4.	**Uyole 96**	Dark red kidney, a very popular commercial variety	1.2-2.5	
5.	**Uyole 98**	Orange, medium seed types	1.5-3.0	
6.	**Wanja**	Large Khaki seeds, adapted to dry areas	1.0-2.0	
7.	**Uyole 03**	Sugar type (red speckled), medium size	1.2-3.0	
8.	**Uyole 04**	Medium size cream seeds	1.5-3.0	
9.	**Njano-Uyole**	Yellow seed, medium size, very popular	1.2-2.5	
10.	**Calima -Uyole**	Large size, Calima and bush	1.5-3.0	

Bean variety description

Name	**Calima –Uyole** 
Seed colour and size	Red
Altitude	1000 – 2000 m.a.sl
Days to maturity	85 days
Yield	Research: 2.2 - 3.0t/ha, Farmer: 1.5-2.5t/ha
Resistance to diseases	Anthracnose, ALS and CBB
Name	**Uyole 94** 
Seed colour and size	Creamy and red mottled
Altitude	800-1800 m.a.sl
Days to maturity	84 days
Yield	Research:2.0 –3.0 t/ha,Farmer:1.0 -1.5 t /ha
Resistance to diseases	ALS , Rust
Name	**Uyole 98** 
Seed colour and size	Intermediate Yellow
Altitude	800-2000 m.a.sl
Days to maturity	87 days
Yield	Research:2.0 – 3.0 t/ha,Farmer: 1.5 – 2.0 t/ha
Resistance to diseases	Anthracnose , ALS, halo blight, Rust, CBB

Bean variety description

Name	**Wanja** 
Seed colour and size	Khaki, large
Altitude	800 - 1600 m.a.sl
Days to maturity	78 days
Yield	Research:1.5 -2.0 t/ha, Farmers: 1.0 – 1.5 t/ha
Resistance to diseases	Tolerance

Name	**Uyole 03** 
Seed colour and size	Cream mottled (sugar bean)
Altitude	800 - 2000 m.a.sl
Days to maturity	97 days
Yield	Research: 2.0 - 2.5 t/ha, Farmer: 1.2 – 1.5 t/ha
Resistance to diseases	Anthracnose, ALS, Halo blight

Name	**Urafiki** 
Seed colour and size	Medium size Red
Altitude	800 - 2000 m.a.sl
Days to maturity	97 days
Yield	Research: 2.0 -3.0 t/ha, Farmer: 1.2 - 1.5 t/ha
Resistance to diseases	Fast to recover from infection

Bean variety description

Name	**Uyole 04** 
Seed colour and size	Creamy, intermediate large
Altitude	800 - 2000 m.a.sl
Days to maturity	97 days
Yield	Research:2.5-3.0t/ha,Farmer:1.5–2.0 t/ha
Resistance to diseases	Anthracnose, ALS, Halo blight
Name	**BILFA-Uyole** 
Seed colour and size	Red Mottled, intermediate large
Altitude	800 - 2000 m.a.sl
Days to maturity	97 days
Yield	Research: 2.0 -2.5 t/ha, Farmer: 1.2 – 1.5 t/ha
Resistance to diseases	Anthracnose, ALS, Halo blight
Name	**Uyole 96** 
Seed colour and size	Large Dark Red kidney
Altitude	800-1800 m.a.sl
Days t o maturity	84 days
Yield	Research:2.0-2.5t/ha,Farmers:1.0–1.5 t/ha
Resistance to diseases	Rust, ALS

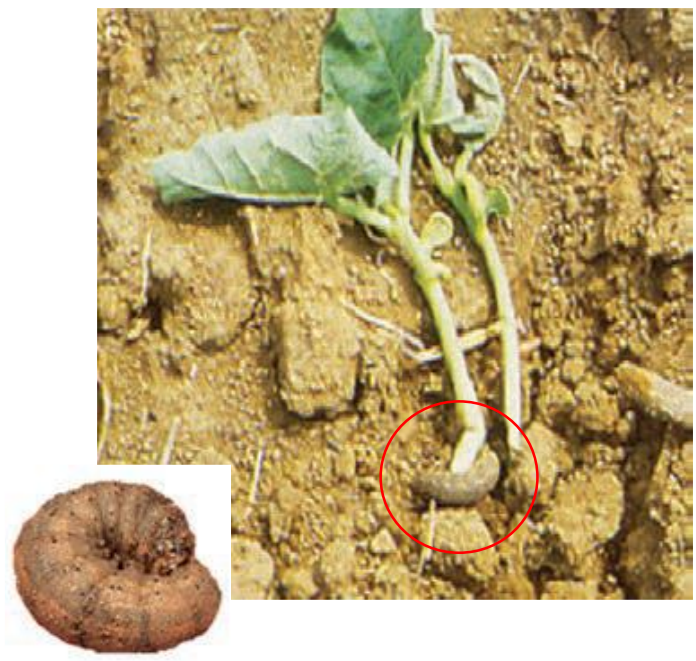
Seedling pests (Agrotis and spodoptera)

Includes cutworms which are generally cosmopolitan and attack seedlings of many crops in the tropics.

They invade the field and cut young seedlings at the base near the ground.

The adults lay eggs, mostly on weeds or other crop plants and sometimes in the soil. Young larvae feed on plants where they hatch.

older larvae migrate to cultivated fields. They burrow into the soil or hide underneath clods during the day and emerge at night.



Cutworm larva at the base of cut bean seedlings

Management strategies.

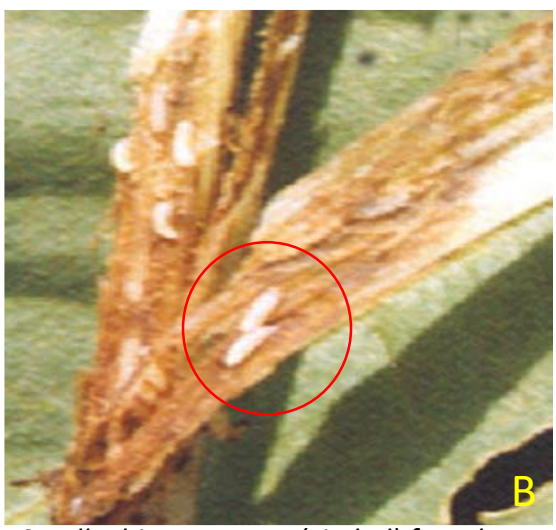
- Digging 5 cm under the ground where the pest hides and crush it.
- In cases of high populations and damage, the larvae can be baited with straw mixed with an insecticide such as Apron star or carbaryl.
- Application of molasses spread in the field.

Bean stem maggot (BSM) (*Ophiomyia spp*.)

- The bean flies are identified by their shiny and clear wings that reflect a metallic blue color in light (**Fig. A**).

- They lay eggs in leaf tissue or directly in the stem. Early signs of attack are egg laying punctures on primary leaves (**Fig. A**).
- The small white maggots then pupate into black or brown puparia (**Fig. B, D**).

Bean flies on the leaves laying eggs



Small white maggots (circled) found beneath the stem epidermis.

Bean plants showing high BSM infestation

Black pupae on the damaged root/stem tissue

Bean stem maggot (BSM) (O*phiomyia spp*.)

Symptoms are characterized by wilting and dying of seedlings (**Fig.E ,F**

BSM severely infected field

Bean plants wilting as a result of BSM

- **Management strategies for BSM**.

- Planting resistant varieties.

- Seed dressing with chemicals containing active ingredients of fungicide and insecticides such as Apron star contains fungicide (metalaxyl-M and difenoconazole) and insecticide (thiamethoxam).

- In cases of planting seeds that are not dressed by chemicals such as Apron star and in order for the farmer to save the crop, he /she can spray the crop with insecticides within 5 days after seed emergence.

- Improvement of soil fertility makes the bean plant vigorous enough to regenerate adventitious root development.

- Hilling up soil around the stem before flowering may stimulate development of adventitious roots for Rhizoctonia, Fusarium and BSM infected plant.

Bean foliage beetle (*Ootheca* spp.)

Widely distributed and attack leaves of leguminous crops and cow peas.

Large swarms of foliage beetles causes total defoliation of the crop.

Great damage is caused by the adult beetles.

Adult beetles

Defoliation from bean foliage beetle

Bean foliage beetle larva on roots

Management strategies of BFB

- Crop rotation with non host crops
- Post harvest tillage exposes the dominant adults to the heat.
- Delayed sowing of beans helps to avoid susceptible stages of the crop.
- Application of the systemic pesticide such as Apron star.

Field diagnosis of bean root rots

Symptomatology: Plant wilting and stunting: Appear as a result of a root or stem rot or vascular wilt disease and bean stem maggots (BSM). Note: Also some viral pathogens cause wilting and stunting.

A field showing plant loss, yellowing and wilting (photo by S. Buah)

Reddish discoloration in the vascular tissues

1. Check for damping off.

- If present, suspect pathogen such as *Fusarium spp*, *Pythium spp*, *Sclerotium rolfsii*, *Rhizoctonia spp.* and *Macrophomina phaseolina*. **(Fig. A).**

2. Check for root lesions.

- If present, suspect *Fusarium spp.* and *Rhizoctonia spp*. and *Macrophomina phaseolina*.

Field diagnosis of bean root rots

3. Check for pithy and hollow tissues .

- If present, suspect *S. rolfsii , Fusarium spp.* or *Pythium* spp.

4. Check for sclerotia and fungal mycelium outgrowth.

- If present, suspect *S. rolfsii* or *Rhizoctonia* spp. (In severe conditions, *Pythium* and *Fusarium spp*. causes mycelial outgrowth above ground).

5. Check for vascular browning

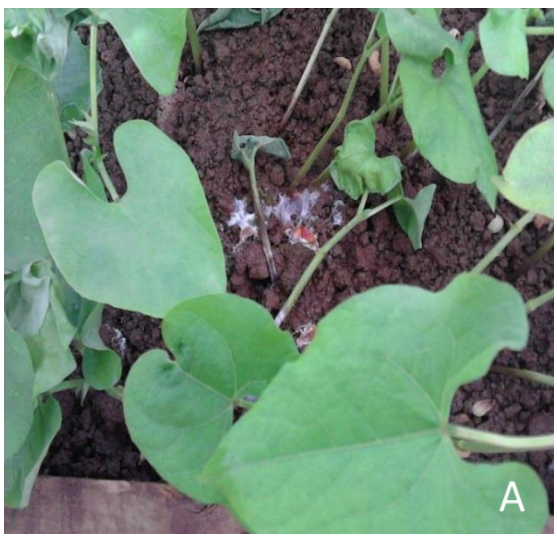
- If present, suspect a fungal wilt (*F. oxysporum* fsp. phaseoli). **(Fig. B**).

Sclerotium root rot:*Sclerotium rolfsii*

Symptoms:

Abundant fan of silky white mould and large round white to brown sclerotia (**Figure A,B,C & D**)

These initially appear on stems and hypocotyl like grey water soaked lesions which later become dark brown and extend downward to tap root (**Figure A & B**)



Bean seedlings damping off

White mycelia on plant surfaces

Stunted bean plant with sclerotia

Sclerotia on pod surfaces

Fusarium root rot: *Fusarium spp.*

Symptoms initially appear as narrow, longitudinal reddish brown lesions or streaks on the hypocotyl and primary root 1–2 weeks after seedling emergence (**Fig. A**).

Lesions may be accompanied by longitudinal fissures or cracks.

In severe infections , primary and lateral roots may die and lower stem tissues become pithy and hollow (**Fig. B**).

Lateral adventitious roots are produced from stem tissues above infected areas (**Fig. C**).

Reddish brown Lesions on roots (photo by J. Bienapl)

Stems with pithy and hollow tissues

Adventitious roots formed at the stem collar

Pythium root rot: *Pythium spp .*

Symptoms: Depends on the time of infection and environmental conditions.

May appear as seed/pod rot, damping off or root rot (**Fig. A**).

Seeds and young seedlings may be attacked shortly after planting, resulting in pre-emergence and post-emergence damping off.

Initial infection symptoms appear as elongated, water soaked areas on roots and stems (**Fig. B**).

In severe infections, primary and lateral roots may die and lower stem tissues become pithy and hollow (**Fig. C**).

Severely infected young seedlings that do not die show extreme stunting , chlorosis and wilting.

Bean pod affected by Pythium root rots (source: plant wise fact sheet)

Damages on roots and stems with water soaked areas

Damage to main root system with pithy and hollow tissues

Rhizoctonia root rot: *Rhizoctonia spp*.

Symptoms:
The pathogen is capable of infecting seeds before germination, resulting in seed decay (**Fig. A**).

Lesions also develop on cotyledons in contact with the moist soil surface causing seed rotting and seed discoloration (**Fig. A**).
Initial lesions on young seedlings appear on lower stem and tap root as reddish brown sunken cankers with delineated borders (**Fig. B**).
The sunken cankers expand slowly and may coalesce to girdle the stem hence may result in formation of lateral adventitious roots (**Fig. D**).

Lesions on cotyledons and seedlings rot

Cankers girdling stems

Seedlings defoliated

Lateral root formed at the stem

Charcoal rot: *Macrophomina phaseolina.*

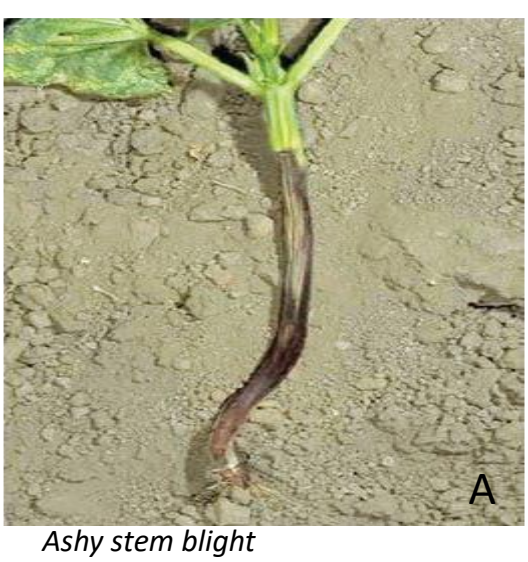
It is most damaging in areas of unreliable rainfall and high temperatures.

It infects the cotyledons and the hypocotyls at soil level producing black, sunken cankers which have a sharp margin and concentric rings.

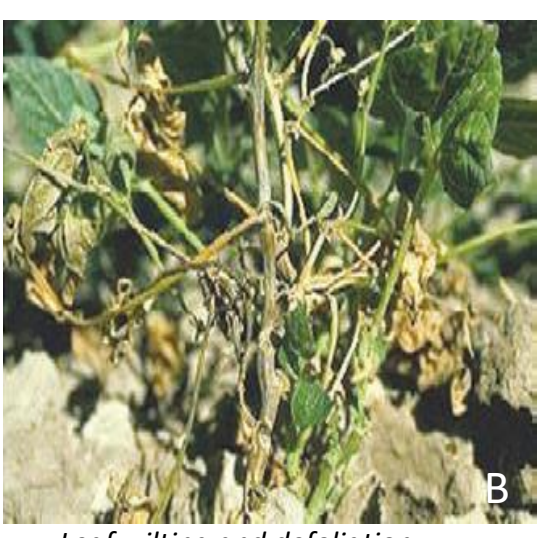
The plant's growing tip may be killed and the stem may break at the cankers.

Young plants have black wounds and stems have ash-like wounds on diseased bean stems (**Fig. A**).

Infection on older plants may cause stunting, leaf chlorosis, wilting, premature defoliation, rotting of the stem and roots, seedling blight and plant death (**Fig. B**).



Ashy stem blight



Leaf wilting and defoliation

Management strategies for bean diseases and insect pests

A combination of the following preventive measures may be used:

- Planting resistant varieties
- Seed dressing with chemicals containing active ingredients of fungicide and insecticides such as Apron star contains fungicide (metalaxyl-M and difenoconazole) and insecticide (thiamethoxam).
- Application of fertilizers; this will enhance plant vigour which makes the plant to tolerant and recovery from disease and insect pests stresses.
- Planting in raised beds or ridges will minimize water logging and enhance soil fertility in hilly and heavy rained areas.
- Hilling up soil around the stem before flowering may stimulate development of adventitious roots for Rhizoctonia, Fusarium and BSM infected plant.
- Deep ploughing of infected plant materials during land preparation.
- Allow the previous crop to be well decomposed prior to planting.
- Practicing a 2–3 year crop rotation with non-host crops such as cereals.